

# Management, Procurement and Law

## The antecedents and development of unsafety

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<b>Abstract:</b>	<p>The concepts of unsafe acts and unsafe conditions within incident and accident reporting processes are well established, and both play a part in safety, as seen in highly complex accident causation models. Nevertheless, a systematic understanding of the development of unsafety to its manifestation as incidents is yet to emerge. Drawing on a large dataset of nearly 4,000 Safety Observation Reports from a large infrastructure construction project, investigation of the way in which incidents are categorised is explored and then, via content analysis of a purposive sample of individual reports, the reality of how the acts and conditions develop, combine and interrelate is evaluated. Findings revealed significant inconsistency in the application of the categorisations of 'act' or 'condition', and utilisation of the process to apportion individual blame through 'unsafe acts'. It can be suggested that within a construction context there are relatively few precursors that produce unsafe acts or conditions, and focusing on these in practice would provide greater insights, enhancing utility without adding significant complexity. Further understanding of how the development of unsafety takes place would enable management to better use reporting data, such as Safety Observation Reports, in the development and implementation of focused interventions.</p>
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37

## 38 **Introduction**

39 The historical development of occupational health and safety management in  
40 construction has in part dictated its lexicon. Early focus was on the identification and  
41 mitigation of physical risks within the workplace, through the provision of machine  
42 guards and controls (Lingard and Rowlinson 2005) which led to prescriptive  
43 management approaches that focused on unsafe conditions through mechanistic  
44 regulations. Subsequently, as the number of accidents decreased focus shifted onto  
45 unsafe acts, through approaches such as behaviour-based safety (Lingard and  
46 Rowlinson 2005), goals and feedback programmes, and most recently notions of  
47 safety climate and culture have emerged (Choudhry et al 2007).

48 A consequence of this 'language of safety' is the way it has shaped and even directed  
49 safety management thinking and practice (Sherratt 2016). Here the area of focus is  
50 that of accident and near-miss reporting , and the legacy of this lexicon can be seen  
51 in the construction of unsafe acts or unsafe conditions as a binary either/or situation.

52 However, accidents are often highly complex in reality, and to use such a simplistic  
53 dichotomy in reporting and subsequent investigation is likely to limit the learning  
54 potential of an incident. Indeed, although 'acts' have come to the fore in terms of  
55 management focus, evidence has shown that organisational factors are often critical  
56 (Lingard and Rowlinson 2005); whilst Hinze (1996) argued that it is always a  
57 combination of physical conditions and worker actions that is the true cause of  
58 accidents on sites.

59 Despite such evidence, unsafe acts and unsafe conditions often remain segregated in  
60 practice, **reinforced by the lexicon itself**. Accident and near miss reporting seeks to  
61 categorise one or the other, with no potential for overlap. Academic advances in  
62 accident analysis have led to the development of ever more complex approaches,  
63 grounded in systems thinking and organisational failure models, yet their utility has  
64 been questioned (Hovden et al 2010). Such models are rarely used in practice, and  
65 would be challenging to apply to near-miss reporting, which is often large scale in  
66 terms of volume, but with relatively little management time available to record,  
67 analyse and act upon them.

68 **'Unsafety' can be considered as the condition of being unsafe. While not a common**  
69 **concept in the field of safety science, it is far from new. Hauer (1992) provides an**  
70 **attempt to quantify unsafety with an attempt to understand the effect of**  
71 **interventions on this concept. More recently, Atsuji (2016) provides a much broader**  
72 **consideration of the term when applied to disasters and accidents.** Drawing on a  
73 large database of 3,956 safety observation reports from a large UK infrastructure  
74 construction project the aims of the work presented in this paper are twofold. First is  
75 an attempt to explore empirically the consequences of a dualistic approach to  
76 unsafety and how acts and conditions combine in practice. The second is to  
77 understand the antecedents and precursors of unsafety with the simple premise that  
78 knowing how unsafety develops may allow the introduction of focussed  
79 interventions.

## 80 **Context**

### 81 **Unsafe Conditions and Unsafe Acts**

82 Early health and safety management was grounded in the elimination of unsafe  
83 working conditions, indeed the earliest UK safety legislation sought to address the  
84 mechanistic problems of exposed mill-gearing in the factories of the industrial  
85 revolution. Developments in technology brought new hazards and risks into  
86 workplaces, and key concerns were to "... find the technical means to safeguard  
87 machinery, to stop explosions and to prevent structures from collapsing" (Hollnagel  
88 2014:24).

89 Within the UK construction industry, unsafe conditions are often addressed through  
90 rigorous legislation, such as that found within Part 4 of the Construction (Design and  
91 Management) Regulations 2015, which sets out amongst other things how stability  
92 of structures must be maintained, how excavations must be managed and how good  
93 order can be kept on sites.

94 Alongside such unsafe conditions relating to the work space can often be found the  
95 concept of unsafe acts, relating to the behaviour of the people who work there. This  
96 is not a new concept – processes of human reliability assessment were developed in  
97 the 1980s to fit alongside the already established risk assessment approach to safety  
98 management. As Hollnagel (2014:30) states, “the idea that human error could be  
99 used to explain the occurrence of adverse events was eagerly adopted”. Application  
100 of cognitive theories enables explanation of such unsafe acts, examples including the  
101 optimism bias, that everything will go right despite risks being taken, the  
102 overconfidence barrier, and the planning fallacy, which results in optimistic  
103 predictions about how long a task will take (Baron et al 2006) which can result in  
104 cutting corners and risk taking when deadlines approach. More generally, Kletz  
105 (2001) suggested that most unsafe acts were the result of a moment of forgetfulness  
106 or aberration, others the result of errors of judgement, which can also be traced back  
107 to inadequate training or supervision. Within the construction industry, Rawlinson  
108 and Farrell (2010) observe that a high tolerance to risk taking is evident, allowing  
109 intentional unsafe acts to form part of everyday site life.

110 A combined approach is to make technology failsafe so unsafe acts cannot lead to an  
111 accident, rather than educate workers through training programmes (Swuste et al  
112 2014), however this is highly problematic within the construction industry, given the  
113 nature of the work. Indeed, the continuing development of technology within the  
114 workplace has led to increasing complexity and coupling between tasks and  
115 activities, therefore interactions cannot necessarily be fully planned, understood or  
116 anticipated (Leveson 2004). This is particularly relevant when many different  
117 subcontractors and long supply chains create complex relationships on sites, which  
118 itself has been found to have negative effects on safety (Manu et al 2010). Although  
119 single failure prevention is often built in to processes and equipment, this means that

120 in practice accidents have shifted to more complicated occurrences with two or more  
121 cumulative failures, which are harder to predict and therefore harder to prevent.  
122 (Hollnagel 2004:3).

123 These ideas of organisational failure (Hollnagel 2004; Hovden et al 2010) and  
124 systemic safety (Dekker 2006) bring together unsafe acts and conditions. Unsafe acts  
125 have become a symptom of deeper latent problems within projects or organisations,  
126 the management system creating situations, or rather unsafe conditions that can  
127 encourage or even force human errors within certain contexts (Perrow 1999; Dekker  
128 2006). As Whittingham (2004:34) states, most violations (unsafe acts) also have a  
129 systemic underlying cause that effectively 'encourages' them. For instance,  
130 competitive tendering for work winning (Morton and Ross 2008); and bonus and  
131 payment schemes that encourage speed and risk taking behaviours (Fellows et al  
132 2002; Spanswick 2007) have both been highlighted as unsafe conditions, or latent  
133 safety defects, in industry operations. However, as Whittingham (2004) argues,  
134 organisations are often unwilling to look too closely at the system faults which  
135 caused the error, and would rather focus on the individual who caused it;  
136 emphasising the unsafe act rather than the systemic cause.

137 On construction sites, where the workplace is subject to continual changes, different  
138 resources, poor working conditions, tough environments and complex co-ordination  
139 of different trades and subcontractors (Pinto et al 2011), performance variability can  
140 be argued to be a necessity, therefore to isolate and label unsafe acts within such  
141 (potentially unsafe) conditions seems incongruous. However, this has not stopped  
142 continued focus on unsafe acts, embedded as they are in the historical language of  
143 safety. Indeed, both acts and conditions, independently and combined in systems  
144 thinking, still hold significant influence on the way accidents, incidents and near  
145 misses are investigated both academically and in practice.

## 146 **The Influences of Accident and Incident Investigation**

147 Statistics form one of the most prominent safety indicators of an industry, providing  
148 'evidence' of safety management in practice. Accident statistics are themselves  
149 lagging indicators (Hinze et al 2013), and learning from past events is a key process

150 for understanding why accidents occur on sites and how future performance can be  
151 improved (Manu et al 2010). Yet investigations of accident causality have developed  
152 highly complex, and at times rather unfathomable, approaches to investigating  
153 incidents from a variety of underlying theories and approaches. Indeed, Grabowski  
154 et al noted the panoply of approaches, and that there have been “ ... few efforts to  
155 harmonise or synthesise the models and methods” (2009, p1187), resulting in an  
156 incoherent body of work. The accident process itself has also seen development from  
157 linear, causal models, which suggest accidents are simply the sequential result of  
158 technical factors, human error or organisational problems (Hovden et al 2010), to  
159 more complex, integrated approaches. As Grabowski et al (2009) note, whilst some  
160 accidents will be the result of immediate causes, cascading through an error chain,  
161 others are much more complex with non-linear interdependencies, drawing on  
162 systems thinking for their theoretical foundation.

163 One of the main goals of accident investigation has been the identification of the  
164 ‘root cause’, and consequently the apportioning of blame (Whittingham 2004).  
165 Accidents are seen as evidence of error or failure, through either an unsafe act or the  
166 emergence of an unsafe condition, and therefore accident investigation becomes the  
167 quest to identify the responsible individual behind the error (Dekker 2011). It can be  
168 argued that this has perpetuated ‘human error’ as a prominent causal factor in  
169 accidents (Whittingham 2004), as the cause becomes easily identifiable as one of  
170 Reason’s (1990) rule, skill and knowledge-based errors or occasional or routine  
171 violations. Yet the quest for root causes has been challenged on a variety of levels,  
172 not least the potential for over-simplification (Grabowski et al 2009). Kletz (2001)  
173 suggested that root cause has an air of finality about it, not always helpful, given that  
174 the cause of many construction injuries is actually gravity. Hollnagel (2004)  
175 suggested that causes are not sought simply for learning, but from desires for  
176 certainty, and the notion we gain knowledge that can be used in future accident  
177 prevention.

178 Systemic, management and organisational factors have also been identified and  
179 incorporated into accident thinking. For example, Hollnagel (2004) proposed a  
180 Functional Resonance Accident Model (FRAM) based on the concepts of emergence.

181 Ferjencik (2011) discussed the notions of singular causality, general causality,  
182 contextual factors, contributory factors and causal factors in the development of an  
183 Integrated Procedure of Incident Cause Analysis (IPICA). Leveson (2004:257) went  
184 further than organisational boundaries in suggesting a general form of a model of  
185 socio-technical control which also acknowledges the influences of legislation,  
186 regulations, certifications, and law.

187 From a practical perspective, this shift to systemic and organisational thinking has  
188 added considerable complexity to the process of accident and incident investigation.  
189 Although it is arguable that a contextual understanding of an accident is a vital part  
190 of its investigation, in order to appreciate the social and technical systems that  
191 surrounded it (Leveson 2004) and enable the development of explanations, rather  
192 than isolated root causes (Hollnagel 2004), it has been questioned whether they  
193 have provided a utilisable fit with the realities of the modern construction workplace  
194 (Hovden et al 2010). Who, one might ask, are the beneficiaries of these theories?  
195 Does the work of the construction safety inspector become easier and more effective  
196 through detailed knowledge of an emergence based accident causality model? Can a  
197 construction worker amend their behaviour through appreciating the difference  
198 between singular and general causality? While the authors don't claim to know the  
199 answers to these questions, experience suggests that there is the potential for the  
200 level of detail and the interactions of these details to develop incoherence and  
201 impracticality, as they increase in numbers and interrelationships. Hovden et al  
202 (2010) suggest that this increasing complexity is incompatible within traditional  
203 linear accident models and whether new approaches are needed , exploring non-  
204 linear perspectives (Ferjencik 2011), although, as before, this may raise its own  
205 problems, as the representations and communication of such approaches may prove  
206 too complex to practically deliver.

207 The uptake of more complicated approaches to investigation has been limited, or  
208 only utilised when serious incidents, such as fatalities, occur. The need for  
209 investigation to support learning, the human desire for categorisation and  
210 management, and the desire to apportion blame where necessary, has arguably  
211 resulted in the reliance on two fundamental root causes previously discussed: unsafe



212 act and unsafe conditions. Nevertheless, in reflecting on the practicalities and  
213 realities of the construction workplace, rather than seeking complexity it is perhaps  
214 this basic approach that should be empirically explored to ascertain its benefits and  
215 limitations, whilst enabling consideration of the relationships between these two  
216 root causes.

## 217 **Safety Observation Reporting**

218 The cataloguing of safety situations, whether tagged as Safety Observation Reports  
219 (SORs), Near-Miss Reporting, Incident reporting etc., often stems from the desire to  
220 measure the safety 'status' of a project. They allow the production of statistics that  
221 are often proudly proclaimed at the entrance to projects, that announce the number  
222 of days or hours worked since the last accident and allow contractors to measure  
223 themselves against industry metrics. They also of course, as Hinze et al (2013)  
224 acknowledge, provide a leading indicator of safety performance

225 In other contexts, however, safety observations can allow an understanding of good  
226 and poor practice on projects. Such Safety Observation Programmes not only  
227 provide a pure statistic of leading or lagging safety performance but attempt the  
228 gathering of richer and perhaps more nuanced descriptions of both safety and also of  
229 unsafety that can lead to better interventions. Unfortunately, as Hallowell et al  
230 (2013) report, the potential benefits of proactive safety control is not well explored  
231 in the literature.

## 232 **Methods**

233 Between March 2013 and July 2014, 3,956 safety observation reports were collected  
234 from a large UK infrastructure construction project (approximate value £800M). For  
235 this dataset any manager or foreman was able to enter details in to an online system  
236 for the attention of the safety department. The person entering the report  
237 categorised it initially as a type of 'observation', either an 'Unsafe Act' or an 'Unsafe  
238 Condition' or as an example of 'Good Practice', and subsequently this observation  
239 was allocated to one of 27 different work 'categories'. A project safety advisor  
240 'checked' this categorisation, and could amend it if necessary, potentially dismissing  
241 it as a non-safety issue, or authorising it for further action. The data used in this

242 analysis is therefore the verbatim reports created by project personnel and was not  
243 gathered by the researchers.

244 A mixed methods approach has been used with these data. Quantitative analysis  
245 was carried out to initially determine the allocation of observations, and then to  
246 establish the relative quantifications of the ascribed categories beneath them. While  
247 a full content analysis of all the safety observations would reveal more about the  
248 actual practices and nature of activities that resulted in the safety report, it is beyond  
249 the scope of this paper. Therefore a qualitative approach was made to three  
250 categories, considered a purposive sample, which could then be examined in depth,  
251 utilising content analysis (Tonkiss 2004) to develop a taxonomy of the data. A  
252 taxonomy can reveal the principles underlying a classification, for example Garrett  
253 and Teizer (2009) provided a taxonomy for human error awareness in construction  
254 safety. Repeated passes of the data enabled the researchers to explore the data  
255 itself and also undertake a process of re-framing, exploring the potential for  
256 alternative categorisations than those originally made, through the lens of the  
257 literature.

## 258 **Findings and Analysis**

### 259 **Quantitative Analysis**

260 Of the 3,956 safety observation reports, 2,128 were categorised as unsafe  
261 conditions, 697 as unsafe acts and 1,131 as good practice. Here only 'unsafety' is  
262 considered and therefore the 'good practice' observations were removed from the  
263 dataset, resulting in 2,825 records. With just over 75% of the observations  
264 considered to be unsafe conditions these data can be considered surprising – they  
265 imply that the majority of unsafe incidents are derived from situations that are not  
266 influenced by human actions. However, this may also be a reflection of the  
267 difficulties of observing fluid and momentary acts when compared to static and  
268 unchanging conditions.

269 A fuller picture of the dataset and of the range of categories to which the reports had  
270 been ascribed can be found in Figure 1, which presents graphically the range of

271 categories as assigned beneath the observations of unsafe acts and unsafe  
272 conditions.

273 In almost all categories it can be seen that the number of unsafe conditions exceeds  
274 the number of unsafe acts, with the exception of 'behaviour'. The inclusion of this  
275 category in itself is interesting – it is neither a work type (such as excavations or  
276 lifting) nor an organisational function (such as permits, PPE or welfare). That there  
277 are any 'unsafe conditions' that can be attributed to behaviour is also interesting and  
278 the data overall suggests either misunderstanding in the categorisation of the safety  
279 observations, or is the manifestation of the complexities of incident reporting when  
280 limited to just categorisations.

281 *[Figure 1: Categorisation of Unsafe Acts and Unsafe Conditions]*

282

### 283 **Qualitative Analysis**

284 In order to further explore the data, and these apparent inconsistencies, three of the  
285 categories were explored to investigate the precursor paths to unsafe acts and  
286 unsafe conditions. Initially considered was the "Behaviour" category, with a further  
287 analysis of the "Hot Works" and the "Work at Height" categories. All data are  
288 extracted from the wider dataset with a 114, 22 and 298 records respectively  
289 analysed, a total of n=434 records. To ensure findings were not restricted to just the  
290 initial 'behavioural' categorisation data, and to attempt to validate the conclusions,  
291 taxonomies were also prepared for two further categories. The 'Hot Works' and the  
292 'Work at Height' category were chosen in order to represent different physical  
293 environments, to represent a wider range of observations and, through 'Work at  
294 Height', to investigate one of the most prevalent sources of injury in construction,  
295 which presumably suggests one of the most common forms of unsafety.

#### 296 *Behaviour Category*

297 The first to be considered was the "Behaviour" category, chosen as this appeared to  
298 the authors as an unusual tag for a category. All of the other categories were areas of  
299 the project, either physical (e.g. "Excavations") or process (e.g. "Traffic

300 Management”) whereas Behaviour is less of a work area and more of a human  
301 action. The process of this analysis was revealing. In the initial dataset, 48  
302 observations were recorded as unsafe conditions but many of these did not fall  
303 under a definition of situations that were unsafe through non-immediate human  
304 means. For example, one report suggested that “Welder welding without screen in  
305 internal stair” was reported as an unsafe condition, presumably because the correct  
306 equipment was not present, but in the researchers’ interpretation the lack of a  
307 screen in a particular area should not be the immediate focus; rather the fact that  
308 the welder chose to continue welding without a screen present is itself poor human  
309 judgement and thus an unsafe act. This consideration of ‘human means’ was used as  
310 a benchmark for classification, while at the same time acknowledging it is arguable  
311 that any classification process is inherently subject to interpretation, as  
312 demonstrated by the data explored here: overall, of the 48 initial such observations  
313 only 5 remained as such following the re-framing process; 90% were changed by the  
314 researchers. This finding illustrates the complexities involved in deciding at what  
315 point an act, or number of acts, eventually emerges into a condition; these decisions  
316 are inherently subjective.

317 However, those observations that remained ‘unsafe conditions’ following the re-  
318 framing process were still supported by the sub-categorisation of behaviour. Here,  
319 and to further develop the previous argument, the underlying premise was that an  
320 act had initiated the condition, although the line between them had been drawn at  
321 the level of the categorisation rather than the observation. For example, the  
322 observation that “road pins for gulley setting out have no protection either place  
323 caps or remove pins”, can be related to behaviour, or rather the omission of the  
324 behaviour to place caps on the pins, but it could also relate specifically to excavation  
325 works. Although this analysis arguably supports more complex, non-linear and  
326 emergent approaches to analysing safety incidents, given the reliance on acts and  
327 conditions it can be suggested that what would actually be of greater utility would be  
328 a clearly defined and shared understanding of the ‘line’ between acts and  
329 consequentially emergent conditions, integrating this concept of behaviour within it.

330 Another notable aspect of these data, revealed by the analytical process, was the  
331 prominence of finger pointing or blaming individuals for their behaviour. For  
332 example “Safety rep parking vehicle in live traffic route to speak to his supervisor”;  
333 “Security guard not using walkways, challenged and re-routed to walkway” are  
334 clearly identifying individuals with some level of authority. While many unsafe act  
335 observations report simply the behaviour of an unidentified individual, 37% directly  
336 identify the individual by name or by the company they work for or by the  
337 registration number of their vehicle. Such data strongly indicates highly complex  
338 social and organisational issues at play that have seeped into the safety observation  
339 process, in part those who create and enforce the policies are readily punished by  
340 others for their violation. Even where individuals are not named, the desire to lay  
341 blame can be found within the data, a fundamental need in incident reporting as  
342 suggested by Whittingham (2004) and Dekker (2011).

343 *[Figure 2: A taxonomy of the Behaviour category of safety observations]*

344 The prepared taxonomy itself, seen in graphical form in Figure 2, was also of interest;  
345 both behavioural acts and conditions easily assigned to either ‘policy’, ‘procedural’ or  
346 ‘equipment’ categorisations, suggesting that a more useful assignment could be  
347 made at a more detailed level within the data, rather than the traditional  
348 act/condition dichotomy. As the taxonomy developed, ‘deliberate’ and ‘inadvertent’  
349 also emerged as key categorisations, ‘deliberate’ further supported by notions of  
350 ‘shortcuts’ and deliberate violations of procedure. It should be noted that this  
351 taxonomy, and those presented later, are intended to be examples of the nature of  
352 unsafety antecedents and are not intended as a generalisation for practice use.

353 *Hot Works Category*

354 To ensure these findings were not restricted to just the ‘behavioural’ categorisation  
355 data, and to attempt to validate the conclusions, taxonomies were also prepared for  
356 two further categories. The ‘Hot Works’ and the ‘Work at Height’ category were  
357 chosen in order to represent different physical environments, to represent a wider  
358 range of observations and, through ‘Work at Height’, to investigate one of the most  
359 prevalent sources of injury in construction, which presumably suggests one of the  
360 most common forms of unsafety.

361 The 'Hot Works' category was a much smaller sub-set of the data (n = 22 reports  
362 that were either unsafe act or unsafe condition) than seen in 'Behaviour', yet the  
363 same taxonomy categories emerged from these data. The only category present in  
364 hot works but not in behaviour was 'missing equipment'. This is itself of interest, as  
365 it could be suggested that equipment has developed beyond its inherent unsafety,  
366 the initial causes behind historical concerns around unsafe conditions (Hollnagel  
367 2014), and rather it is unsafe acts involving this equipment that have become more  
368 relevant to practice. The taxonomy for hot works can be seen in Figure 3.

369 *[Figure 3: A taxonomy of the Hot Works category of safety observations]*

370 In the preparatory process of this second taxonomy, similar observations were made  
371 as for the behaviour category. Reports again appeared to be incorrectly categorised  
372 as unsafe condition when could be more appropriately labelled unsafe act (50% were  
373 changed) and those that identified individuals or companies and could be considered  
374 'blame reports' (27%), though both were not to the same extent as for 'behaviour'.

#### 375 *Work at Height Category*

376 A final investigation was undertaken on a category with a significantly higher number  
377 of observations (n=298). Once again each observation record was considered in  
378 terms of the type of unsafety identified by the initial observer and then, if necessary,  
379 this was reframed by the researchers. In total it was decided to change 92 records, or  
380 31%, all but three of these being changes from 'Unsafe Condition' to 'Unsafe Act'. For  
381 example, one observation recorded that "Modifications have been carried out to  
382 crane suspended access basket i.e. extra section welded to front" should be  
383 categorised as an Unsafe Condition but to the researchers this was a clear Unsafe  
384 Act. As before, the categorisation can be seen as a reflection of the 'distance'  
385 between the Unsafe Condition recorded and the Unsafe Act that led to that  
386 condition. The reframing of unsafety resulted in a total of 58% categorised as an  
387 Unsafe Act with the remaining 42% being Unsafe Conditions.

388 While almost all observations stem from an unsafe act at some point in the  
389 development of the particular example of unsafety, the decision by the researchers  
390 on which type to reframe it as came down to whether that act took place at the

391 location of the actual unsafety. For instance, “Open edges around external  
392 jumpform” was an observation recorded as an Unsafe Condition and this category  
393 was kept as the unsafe act which led to this unsafety was assumed to have occurred  
394 some time before the jumpform was actually used. On the other hand, “Toe-Boards  
395 Missing, Installation of perimeter walkway” was initially categorised as an Unsafe  
396 Condition but was changed by the researchers as it was considered an act of unsafety  
397 occurring at the time of observation.

398 The graphical taxonomy for ‘Work at Height’ is shown in Figure 4. Four levels of  
399 antecedent categorisation were applied and for the first level an attempt was made  
400 to stay with the same tags as applied to the ‘Behaviour’ and ‘Hot Works’ categories,  
401 i.e. Policies, Equipment and Procedures. Thereafter the precursors and antecedents  
402 changed slightly to reflect the nature of the ‘Work at Height’ unsafety observations,  
403 though many similarities remained.

404 *[Figure 4: A taxonomy of the Work at Height category of safety observations]*

405 For example, Inappropriate Equipment Use, Shortcut, Poor Practice, PPE are  
406 common to both ‘Work at Height’ and ‘Behaviour’, as are the considerations of  
407 whether the unsafety was Inadvertent or Deliberate. But many of the precursor tags  
408 are different – in general it can be seen that most tags in the ‘Work at Height’  
409 category are physical or situational (for example, Missing Equipment,  
410 Damage/Failure, Design Issue) while those in the ‘Behaviour’ category are indeed  
411 acts of behaviour, such as Texting, Not Following Instructions or Smoking.

412 All three taxonomies have common elements, however, and an attempt has been  
413 made to draw out in the last or upper level of precursor categorisation an  
414 identification of the behaviour or situation that has eventually led to the observation  
415 of unsafety. In total across all three taxonomies there are seventeen separate  
416 precursors or antecedents to unsafety and it is these that we propose are the focus  
417 of interventions.

## 418     **Unsafty Antecedents**

419     The ease with which the same categorisations were identified in the preparation of  
420     both taxonomies suggest there may be a common pattern to how unsafety can be  
421     understood in terms of ‘antecedents’, by which we mean those situations, issues,  
422     aspects and factors of operations and activities which existed before an unsafe act or  
423     unsafe condition occurs. To bring all three taxonomies together, these  
424     categorisations have been combined within the broader considerations of time, as  
425     shown in Figure 5, which essentially ‘flips’ the taxonomies to reflect practice.  
426     Generally, equipment, procedures (and, to a lesser extent, policies) can be identified  
427     as the domain, decisions and triggers the antecedents which are categorised as  
428     either inadvertent or deliberate within the area of activity closest to practice, thus  
429     leading to a state of unsafety either as act or condition.

430     *[Figure 5: The development of unsafety]*

## 431     **Conclusions**

432     Through content analysis of 434 Safety Observation Reports taken from a larger  
433     dataset of nearly 4,000, a greater understanding of the nature of unsafety as  
434     perceived by those undertaking construction work emerges. The process of analysis  
435     revealed both complexities and subjectivity within the reporting process, and in  
436     certain case an underlying desire to apportion blame. This raises questions of the  
437     motivation for creating reports; to point fingers, particularly at those in authority, or  
438     to genuinely attempt to improve conditions. Projects and organisations undertaking  
439     safety reporting of this nature should seek to ensure this does not undermine the  
440     utility of the exercise.

441     The categorisation of unsafe acts and unsafe conditions was found to be highly  
442     subjective, and likely dependent first on a robust definition of what constitutes an  
443     ‘act’ and what a ‘condition’; and secondly on individuals’ interpretation of this  
444     definition. This was also apparent during the analysis, where the researchers’  
445     reallocation of categorisations was of course to some extent itself inevitability  
446     subjective, something which adds inherent and inevitable complexity to this type of  
447     research. Many reported unsafe conditions were deemed by the researchers to



448 actually be unsafe acts. In some ways the initial categorisation by site staff is  
449 contrary to the conclusions of Whittingham (2004), who argues that organisations  
450 would rather focus on the error of the individual. Yet the contextual descriptions of  
451 each observation challenge this further – while many clearly indicate human error,  
452 most unsafe acts were categorised as systemic conditions. If such labels are to be  
453 used then clearer and objective definitions are needed for consistency of reporting,  
454 to mitigate the subjective nature of the process.

455 Preparation of taxonomies on three subsets of the overall data enabled a broader  
456 and more detailed understanding of how unsafety develops, and also that this  
457 development was very similar for both acts and conditions. Rather than being  
458 considered as two ends of a single spectrum, they are perhaps instead two artificial  
459 constructs superimposed on a development of unsafety, that has roots in decisions  
460 made either consciously or unconsciously; deliberately or inadvertently. It is  
461 suggested that further research explore these antecedents in practice, including the  
462 utility of its application to existing reporting processes to ensure its ability to  
463 enhance, rather than over-complicate, existing industry reporting procedures.

464

## 465 **Figure List**

466 **Figure 1: Categorisation of Unsafe Acts and Unsafe Conditions**

467 **Figure 2: A taxonomy of the Behaviour category of safety observations**

468 **Figure 3: A taxonomy of the Hot Works category of safety observations**

469 **Figure 4: A taxonomy of the Work at Height category of safety observations**

470 **Figure 5: The development of unsafety**

471

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Figure 1

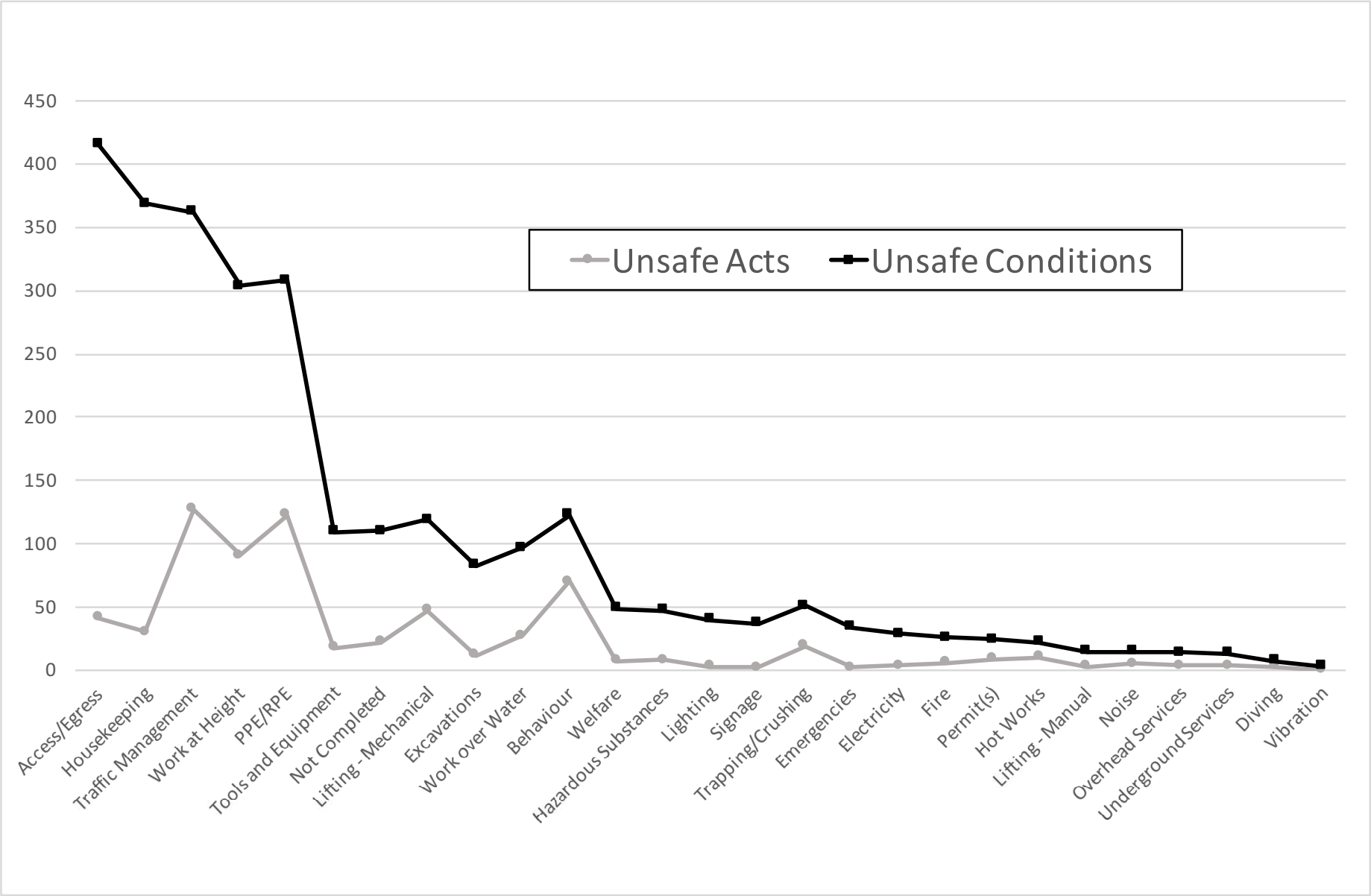


Figure 2

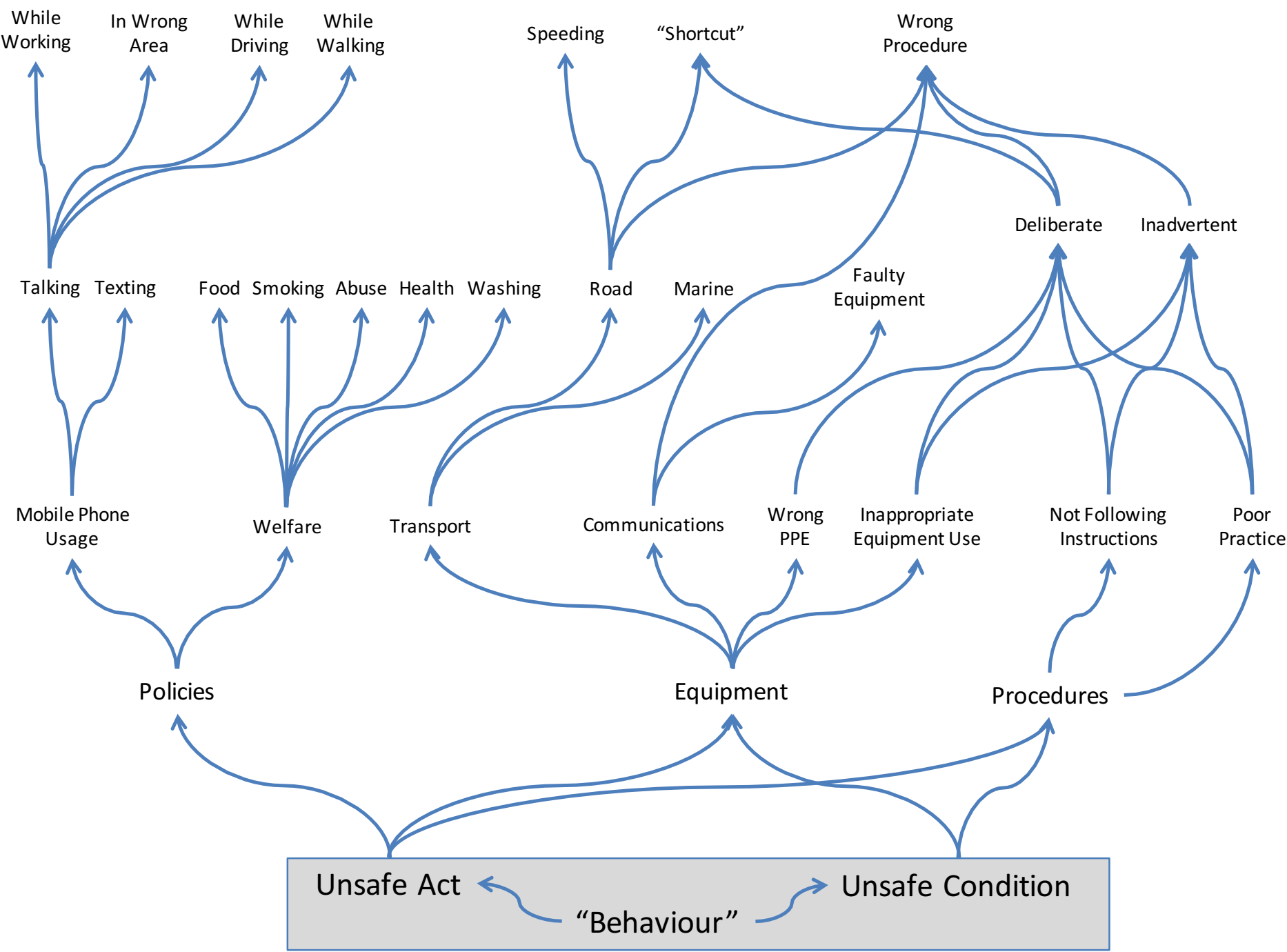


Figure 3

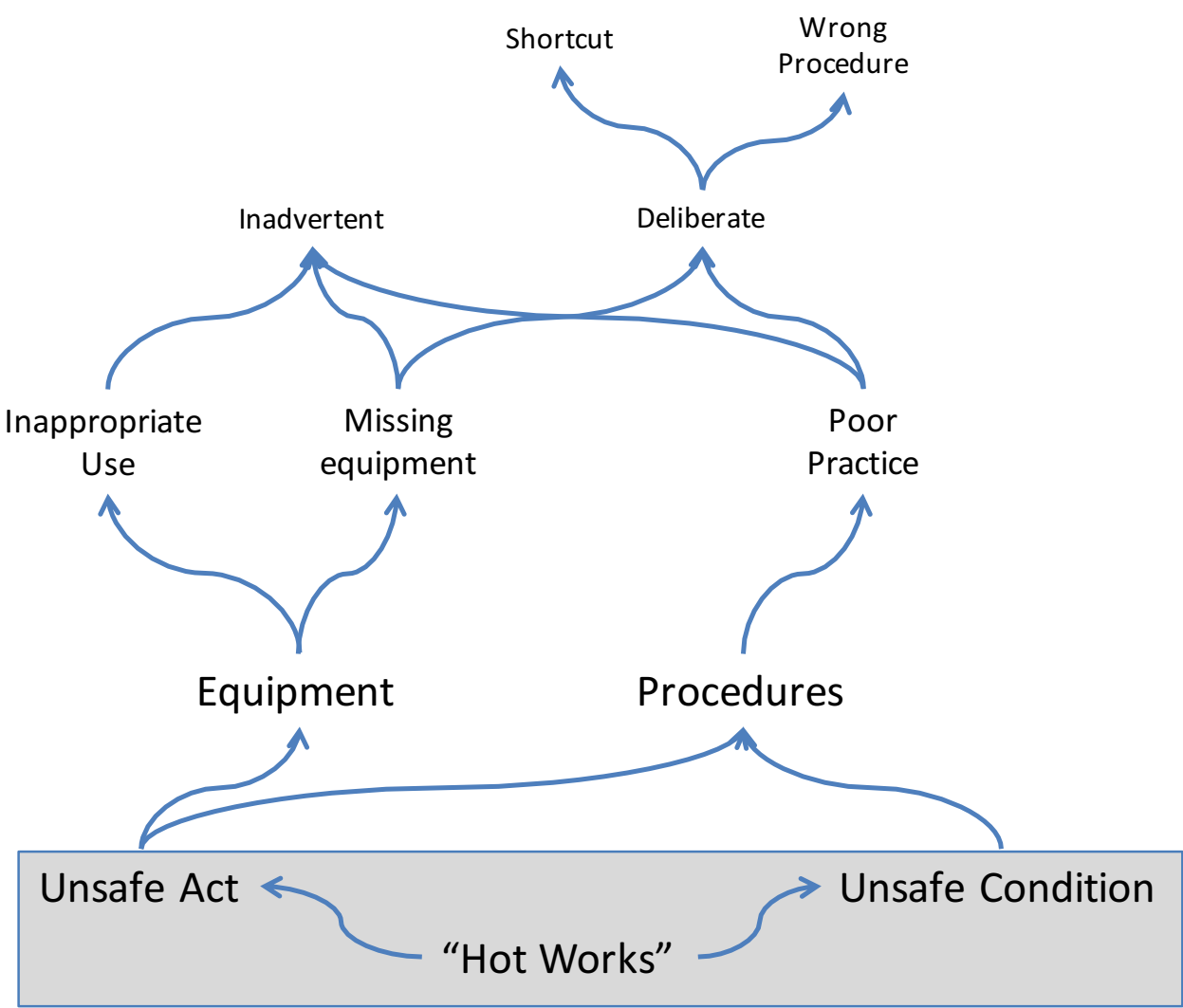


Figure 4

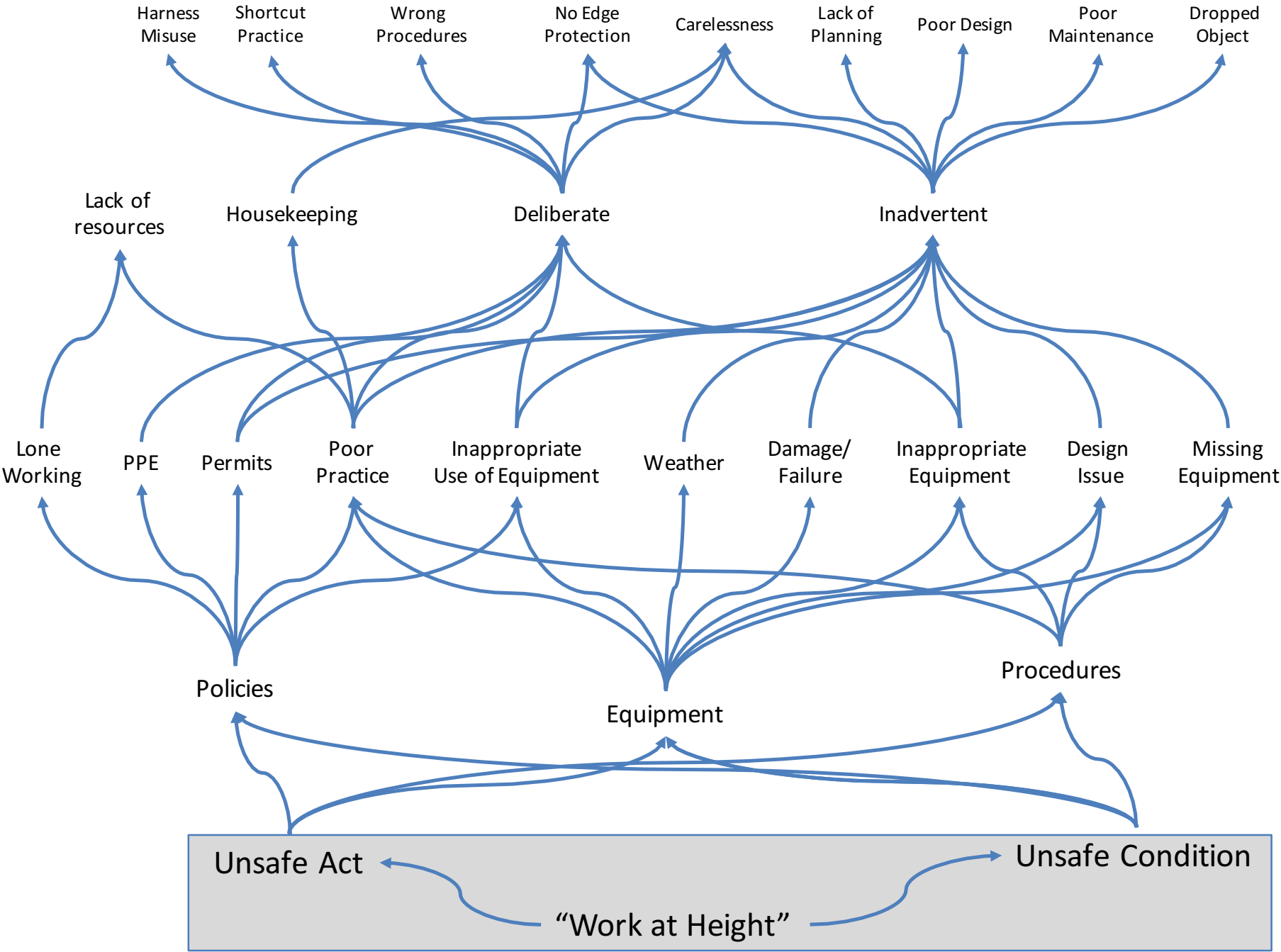




Figure 5

